1. "Figure 9 of Zakhidov, et al shows that the porous material has all the structural limitations as recited in claim 1."

2. "Zakhidov, et al discloses that the carbon forms that are preferred for his invention are polycrystalline diamond, and doped diamond. Diamond is clearly a light emitting or light transmittal photonic crystal."

Both of these reasons are technically incorrect.

<u>Figure 9 of Zakhidov, et al does NOT show that the porous material has all the structural limitations as recited in claim 1.</u>

Zakhidov, et al certainly show a two or three dimensionally periodic microporous structural matrix of interconnecting, crystallographically oriented, monodispersed members having voids between adjacent members. However, that is where the similarity ends. Nowhere is Zakhidov, et al do they even mention a microporous structural matrix additionally having random nanoporous surface porosity. Figure 9 of Zakhidov, et al does NOT show members additionally have randomly nanoporous surface porosity. The black spots on the inverse opal structural members of Fig. 9 are not random nanopores, but rather they are voids through which the dissolved template sphere material was removed. While Fig.9 appears to show the template spheres, this is really an optical illusion. The inverse sphere material structure may be better visualized in Figs. 3-7. Nowhere in Zakhidov, et al, do teach or suggest nanopores superimposed on micropores.

<u>Diamond is NOT clearly a light emitting or light transmittal photonic crystal.</u>

"Zakhidov, et al certainly discloses polycrystalline diamond, and doped diamond. However, these are only for a two or three dimensionally periodic microporous structural matrix and NOT nanopores superimposed on their micropores. In addition, diamond is NOT clearly a light emitting or light transmittal photonic crystal. While diamond chemistry might be suitable to construct a light emitting or light transmittal photonic crystal, it is not the material, but rather the *structure* of the material which is produced which determines whether it is a light emitting or light transmittal photonic crystal. The

type of diamond employed by Zakhidov, et al is not like a diamond engagement ring. Rather, they are industrial diamonds which are usually gray in color. While one may intentionally transform their topographical structure, according to the techniques of the present invention, and make them into a light emitting or light transmitting photonic crystal, they are not inherently light emitting or light transmitting photonic crystals, nor are they taught to be such by following the teachings of Zakhidov, et al. In this regard, should the examiner maintain this reason for rejection, the applicants call upon the examiner to produce prior art to support his position that "Dianmond is clearly a light emitting or light transmitting photonic crystal".

For these reasons it is submitted that all grounds of rejection employing the teachings of Zakhidov, et al should be rescinded. It is understood that the amendment submitted on January 9, 2004 will be entered in conjunction with this Request for Continued Examination. In order to be completely responsive, applicant's arguments from the amendment submitted on January 9, 2004 are repeated.

Applicants' claims describe a light emitting or light transmitting photonic crystal having a randomly nanoporous surface porosity. U.S. patent 6,261,469 to Zakhidov et al. at column 4, lines 52-57 teaches only a carbon foam having an average pore diameter of about 4Å to about 10Å, which carbon foam is not a light emitting or light transmitting photonic crystal. The previously submitted declaration from Dr. Ray H. Baughman, a co-inventor of the present application *and a co-inventor of the applied reference to Zakhidov, et al.* declares that the carbon foam described at column 4, lines 52-57 of Zakhidov, et al. is not a light emitting or light transmitting photonic crystal which comprises a two dimensionally periodic or three dimensionally periodic microporous structural matrix of interconnecting, crystallographically oriented, monodispersed members having voids between adjacent members, and said members additionally having randomly nanoporous surface porosity.

The Examiner has subjected this application to restriction under 35 U.S.C. 121. The Examiner has formed two groups of claims, Group I drawn to claims 1-17 and 45-49 for a

photonic crystal, a structure and a device, and Group II drawn to claims 18-44 for processes of the invention. The Examiner has asserted that these groups of claims represent distinct inventions and may properly be restricted. Applicants have provisionally elected the examination of claims 1-17 and 45-49 from Group I with traverse. Reconsideration of the requirement is hereby requested. 35 U.S.C. 121 requires a showing of independence and distinctness before a restriction is proper. In the instant case the Examiner is alleging that the inventions of groups one and two are distinct, although no showing of such distinctness has been made. Applicants respectfully assert that claims 1-37 together are linked to form a single inventive concept which should be examined together. Therefore, Applicants respectfully request that the restriction requirement be withdrawn.

Additionally, Applicants respectfully request that the method claims be rejoined under In Re Ochiai 37 USPQ2d 1127 and In re Brouwer 37 USPQ 1663. The method claims have been amended to include the limitations of the article claims.

Claims 1-12, 15 and 16 stand rejected under 35 U.S.C. 102(a) or 35 U.S.C. 103(a) over U.S. patent 6,261,469 to Zakhidov et al. It is respectfully submitted that the rejection has been overcome. In an amendment filed on August 6, 2003, the claims were amended to specify that the photonic crystals or photonic devices of the claimed invention are light emitting or light transmitting. This feature is neither taught nor suggested by the applied references. As discussed herein, the invention provides a light emitting or light transmitting photonic crystal, and a structure formed therefrom, which comprises a two dimensionally periodic or three dimensionally periodic microporous structural matrix of interconnecting, crystallographically oriented, monodispersed members having voids between adjacent members, and said members additionally having randomly nanoporous surface porosity superimposed on the microporosity.

Zakhidov does teach the formation of three-dimensionally periodic microporous structures and functional composites. However, Zakhidov does not further teach or

suggest any steps by which a randomly nanoporous surface porosity is provided on the microporous structure to produce a light emitting or light transmitting structure. The Examiner points to col. 4, lines 52-57 of Zakhidov et al. where the reference describes a three-dimensionally periodic carbon foam structure having average pore diameters of from about 4 Å to about 10Å. However, carbon is neither a light emitting nor a light transmitting material. More importantly, Zakhidov et al. does not teach or suggest any microporous structure having randomly nanoporous surface porosity which is also capable of emitting and/or transmitting light.

As described in Applicants' specification, nanoporosity is responsible for the emission of light and the periodic microporosity of the photonic crystal structure controls the propagation of the emitted photons. The Examiner argues that since Zakhidov et al. teaches a carbon foam structure having average pore diameters of from about 4 Å to about 10Å, and Applicants state that nanoporosity is responsible for the emission of light, that the carbon foam structure of Zakhidov et al. is therefore light emitting. This is not correct. It is respectfully submitted that Applicants' statement that nanoporosity is responsible for the emission of light does not apply to structures that are inherently not light emitting or light transmitting. As set forth in the Declaration under 37 C.F.R. § 1.132, the carbon foam structure described at col. 4, lines 52-57 of Zakhidov et al. does not provide a light emitting or light transmitting photonic crystal.

In no respect does Zakhidov et al. teach or suggest a light emitting or light transmitting structure having a randomly nanoporous surface porosity on the micropores as defined by Applicants. Indeed, Zakhidov et al. goes no further than discussing steps for the removal of their material A from an A-B composite structure. Accordingly, the structure as described by Applicants is structurally different than any structure described by Zakhidov et al.

For these reasons, it is respectfully asserted that Zakhidov et al. do not teach every element of the claimed invention, and that the claimed invention is not anticipated by

Zakhidov et al. It is respectfully submitted that the rejection has been overcome and should be withdrawn.

Claims 13 and 14 stand rejected under 35 U.S.C. 103(a) over Zakhidov et al. in view of Russell et al. (U.S. patent 6,093,941). It is respectfully submitted that the rejection has been overcome. The arguments with regard to Zakhidov et al. apply equally herein and are repeated from above. Russell et al. teaches a light emitting photonic structure having a transparent substrate supporting a layer of group IV semiconductor material having at least one porous region. The Examiner has applied Russell et al. to show that a photonic band gap material can be deposited on a sapphire substrate. It is respectfully asserted that the combination with Russell et al. fails to overcome the differences between Zakhidov et al. and the claimed invention. More specifically, the combination of Zakhidov et al. and Russell et al. still fails to teach or suggest a microporous structure having superimposed randomly nanoporous surface porosity which is also capable of emitting and/or transmitting light. For these reasons, it is submitted that the rejection has been overcome and should be withdrawn.

Claim 17 stands rejected under 35 U.S.C. 103(a) over Zakhidov et al. in view of Koops (U.S. patent 6,064,506). It is respectfully submitted that the rejection has been overcome. The arguments with regard to Zakhidov et al. apply equally herein and are repeated from above. Koops teaches an optical multipath switch with electrically switchable photonic crystals. The Examiner has applied Koops to show that it would be obvious to have a liquid crystal material imbibed on the photonic crystal of the invention. However, similar to Russell et al., the combination with Koops fails to overcome the differences between Zakhidov et al. and the claimed invention. More specifically, the combination of Zakhidov et al. and Koops still fails to teach or suggest a microporous structure having superimposed randomly nanoporous surface porosity which is also capable of emitting and/or transmitting light. For these reasons, it is submitted that the rejection has been overcome and should be withdrawn.

Claims 45, 46, 48 and 49 stand rejected under 35 U.S.C. 103(a) over Zakhidov et al. in view of Jewell (U.S. patent 5,617,445). It is respectfully submitted that the rejection has been overcome. The arguments with regard to Zakhidov et al. apply equally herein and are repeated from above. Jewell teaches a quantum cavity light emitting element having cavities and a light emitting material within the cavities. The Examiner has applied Jewell to show that it would be obvious to deposit a metal layer on opposite surfaces of a photonic crystal. The Examiner has also applied Jewell to show that it would be obvious to have a light emitter positioned to direct light onto the photonic crystal of the invention, and also to show that it would be obvious for such a light emitter to transmit light having the claimed wavelength range. However, similar to Russell et al. and Koops, it is respectfully asserted that the combination of Zakhidov et al. with Jewell fails to overcome the differences between Zakhidov et al. and the claimed invention. More specifically, the combination of Zakhidov et al. and Jewell still fails to teach or suggest a microporous structure having superimposed randomly nanoporous surface porosity which is also capable of emitting and/or transmitting light. For these reasons, it is submitted that the rejection has been overcome and should be withdrawn.

Claim 47 stands rejected under 35 U.S.C. 103(a) over Zakhidov et al. in view of Jewell and further in view of Koyama et al. (U.S. patent 6,462,356). It is respectfully submitted that the rejection has been overcome. The arguments with regard to Zakhidov et al. and Jewell apply equally herein and are repeated from above. Koyama et al. teaches a light emitting device having a light emitting section and a waveguide section on a substrate, which waveguide section transmits light from the light emitting device section. The Examiner has applied Koyama et al. to show that it would be obvious to have an electrode attached to the electrically conductive, optically transparent layers of the claimed invention. However, similar to Russell et al. and Koops, it is respectfully asserted that the combination of Zakhidov et al. with Jewell and Koyama et al. fails to overcome the differences between Zakhidov et al. and the claimed invention. More specifically, the combination of Zakhidov et al., Jewell and Koyama et al. still fails to teach or suggest a microporous structure having randomly superimposed nanoporous

surface porosity which is also capable of emitting and/or transmitting light. For these reasons, it is submitted that the rejection has been overcome and should be withdrawn.

The Examiner has rejected claims 1-3 and 6 under 35 U.S.C. 102(e) or 35 U.S.C. 103(a) over Ichimura et al. (U.S. patent 6,456,416). It is respectfully submitted that the rejection is not well taken. Ichimura et al. teaches a process and device for producing a photonic crystal and optical element. More specifically, Ichimura et al. describes a process for producing an optical element comprising a photonic crystal in which spots having different indices are arranged periodically, comprising the step of exposing an optical medium whose refractive index changes by irradiation of light or by a predetermined treatment conducted after the irradiation of light according to the intensity of the applied light to a field where light intensity changes in space at a period of the wavelength order of light and holding the optical medium for a given time, and the step of repeating at least once the step of creating another field where light intensity changes in space at a period of the wavelength order of light by shifting the optical medium. Ichimura et al. disclose that their optical medium may be a porous material with a photopolymerizable monomer impregnated thereinto, and that the impregnated photopolymerizable monomer at a portion where an intensity of the irradiated light is lower than the reminder is removed by the treatment of the chemical in said forming step. However, Ichimura et al. fails to disclose each element of the claimed invention. Particularly, Ichimura et al. fail to disclose a light emitting or light transmitting two dimensionally periodic or three dimensionally periodic microporous structural matrix of interconnecting, crystallographically oriented, monodispersed members having voids between adjacent members, and said members additionally having randomly nanoporous surface porosity. As discussed above, the nanoporosity is responsible for the emission of light, and the periodic microporosity of the photonic crystal structure controls the propagation of the emitted photons. Compared to conventional porous silicon, the claimed material has a much larger active surface area since the whole volume of the material is used in the process for creating nanoporosity. The nanoporosity is created on the device after the periodic microporosity has been created. This is unlike the process for the formation of

conventional porous silicon via various chemical etching processes where only the surface of the bulk silicon is exposed to an etchant. Thus, the photoluminescence in these silicon nanofoams is enhanced by about ten-fold over conventional porous silicon. Additionally, Ichimura neither teaches nor suggests such a light emitting or light transmitting photonic structure. For these reasons it is respectfully submitted that the rejection is incorrect and should be withdrawn.

The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,

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I hereby certify that this paper is being facsimile transmitted to the Patent and Trademark Office (FAX No. 703-872-9306) on April 12, 2004.

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